not adhere tightly to substrate), seven (24 percent) are foliose (having leaf-like lobes, attached in the center to substrate by clusters of rhizomes) and two (7 percent) are fruticose (plant-like growth attached at one point).

4.6.6 Biodiversity

The Hanford Site is located within the Columbia Basin Ecoregion, an area that historically included over 6 million ha (14.8 million ac) of steppe and shrub-steppe vegetation across most of central and southeastern Washington state, as well as portions of north-central Oregon. The pre-settlement vegetation consisted primarily of shrubs, perennial bunchgrasses, and a variety of forbs. An estimated 60 percent of shrub-steppe in Washington has been converted to agriculture or other uses. Much of what remains is in small parcels, in shallow rocky soils, or has been degraded by historic land uses (mostly livestock grazing) (TNC 1999).

The Hanford Site retains some of the largest remaining blocks of relatively undisturbed shrub-steppe in the Columbia Basin Ecoregion. Hanford's importance as a refuge for the shrub-steppe ecosystem is not solely size-related, however. The presence of a high diversity of physical features and examples of rare, undeveloped deep and sandy soil has led to a corresponding diversity of plant and animal communities. Many places on the Hanford Site are relatively free of non-native species and are extensive enough to retain characteristic populations of shrub-steppe plants and animals that are absent or scarce in other areas. Because of its location, the site provides important connectivity with other undeveloped portions of the ecoregion.

4.7 Cultural, Archaeological, and Historical Resources

The Hanford vicinity is one of the most culturally rich resource areas in the western Columbia Plateau. The site consists of a series of cultural landscapes containing the cumulative record of multiple occupations by Native and non-Native Americans. These landscapes contain numerous well-preserved archaeological sites representing prehistoric, ethnographic, and historic periods. Period resources include sites with cultural materials that are thousands of years old, traditional cultural places, and buildings and structures from the pre-Hanford, Manhattan Project, and Cold War eras. The National Historic Preservation Act (16 USC 470), the Native American Graves Protection and Repatriation Act (25 USC 3001 et seq.), the Archaeological Resources Protection Act (16 USC 469 et seq.), and the DOE American Indian Policy (DOE 2000), among other legislation and guidelines, require the identification and protection of areas and resources of concern to the Native American community (see Sections 6.13 and 6.14).

4.7.1 Native American Cultural Resources and Archaeological Resources

Traditional Native American religion is manifest in the earth, the water, the sky, and all animate or inanimate beings that inhabit a given location. In prehistoric and early historic times, Native Americans of various tribal affiliations populated the Hanford Reach of the Columbia River. The Wanapum and the Chamnapum dwelt along the Columbia River from south of Richland upstream to Vantage (Relander 1956; Spier 1936). Some of their descendants (Wanapum) still live nearby at Priest Rapids;

others live on the Yakama and Umatilla Reservations. Palus people, who lived on the lower Snake River, joined the Wanapum and Chamnapum to fish the Hanford Reach of the Columbia River and some inhabited the east bank of the river (Relander 1956; Trafzer and Scheuerman 1986). Many descendants of the Palus now live on the Colville Reservation. The Nez Perce, Yakama, Walla Walla, and Umatilla, and other Native American peoples also periodically visited to fish in the area. Traditional uses of the Hanford Site included fishing, hunting, and gathering roots and medicinal plants. The area was also used as a wintering ground. Descendants of these people retain traditional secular and religious ties to the region and many have knowledge of the ceremonies and life ways of their ancestral culture.

The Hanford Reach and the greater Hanford Site, geographic centers for regional Native American religious belief, are central to the practice of Indian religion of the region, and many believe the creator made the first people here (DOI 1994). Indian religious leaders began their teachings here, including Smoholla, a prophet of Priest Rapids who brought the Washani religion to the Wanapum and others during the late nineteenth century. Native plant and animal foods, some of which can be found on the Hanford Site, are used in the ceremonies performed by tribal members. Certain landforms, especially Rattlesnake Mountain, Gable Mountain, Gable Butte, and various sites along and including the Columbia River, remain sacred to them. Aesthetic and scenic resources are discussed in Section 4.8.10. The Gable Mountain Block Survey conducted by tribal members in 2000, recorded important attributes that contribute to the significance of Gable Mountain to Native Americans (Poston et al. 2001). Native American traditional cultural places within the Hanford Site include, but are not limited to, a wide variety of places and landscapes: archaeological sites, cemeteries, trails and pathways, campsites and villages, fisheries, hunting grounds, plant-gathering areas, holy lands, landmarks, important places in Indian history and culture, places of persistence and resistance, and landscapes of the heart (Bard 1997). Traditional cultural places of importance to Native Americans are determined through methods that are mutually agreed upon by DOE and the Native American community.

Native Americans have lived in and around the present-day Hanford Site for thousands of years (Relander 1956; Spier 1936; Sturtevant and Walker 1998). When Euro-Americans arrived in the 1800s, peoples presently referred to as the Wanapum inhabited villages and fishing camps. Neighboring groups known today as the Yakama, Umatilla, Cayuse, Walla Walla, Palus, Nez Perce, and Middle Columbia Salish frequented the area to trade, gather resources, and conduct other activities. Many descendants of these tribes are affiliated with the Wanapum, Yakama Nation, Confederated Tribes of the Umatilla Indian Reservation, Nez Perce Tribe, or the Confederated Tribes of the Colville Reservation, and they retain traditional, cultural, and religious ties to Hanford's places and resources. (See Section 6.14 for further information on the treaties associated with the Hanford Site). This record of Native American use and history is reflected in the archaeological sites and traditional cultural places that are located across the Hanford Site.

People have inhabited the Middle Columbia River region since the end of the glacial period. More than 8000 years of prehistoric human activity in this largely arid environment have left extensive archaeological deposits along the river shores (DOE-RL 2003a; Leonhardy and Rice 1970). Well-watered areas inland from the river also show evidence of concentrated human activity (Chatters 1982; DOE-RL 2003a; Daugherty 1952; Leonhardy and Rice 1970; Neitzel 2002a), and recent surveys have

indicated extensive, although dispersed, use of arid lowlands for hunting. Throughout most of the region, hydroelectric development, agricultural activities, and domestic and industrial construction have destroyed or covered the majority of these deposits. Amateur artifact collectors have had an immeasurable impact on what remains at numerous sites. However, by virtue of their inclusion in the Hanford Site from which the public is restricted, archaeological deposits found in the Hanford Reach of the Columbia River and on adjacent plateaus and mountains largely have not been destroyed.

Archaeological sites and isolated finds totaling 439 associated with the prehistoric period have been recorded on the site; of these, approximately 68 contain historic components as well. Prehistoric period sites common to the Hanford Site include remains of numerous pit house villages, various types of open campsites, spirit quest monuments (rock cairns), hunting camps, game drive complexes, and quarries in nearby mountains and rocky bluffs (Rice 1968a, b; Neitzel 2002a); hunting/kill sites in lowland stabilized dunes; and small temporary camps near perennial sources of water located away from the river (Rice 1968b).

Many recorded sites were found during four archaeological reconnaissance projects conducted between 1926 and 1968 (Krieger 1928; Rice 1968a,b). Much of this early archaeological survey and reconnaissance activity concentrated on islands and on a strip of land about 400 m (1300 ft) wide on either side of the river (Neitzel 2001). Reconnaissance of selected locations conducted through the mid-1980s, as well as systematic archaeological surveys conducted from the middle 1980s through 1996, added to the recorded site inventories, (DOE-RL 2003a; Chatters and Cadoret 1990; Chatters and Gard 1992; Chatters et al. 1990, 1991, 1992; Last et al. 1994; Andrefsky et al.1996).

During his reconnaissance of the Hanford Site in 1968, Rice (1968b) inspected portions of Gable Mountain, Gable Butte, Snively Canyon, Rattlesnake Mountain, and Rattlesnake Springs. Rice also inspected additional portions of Gable Mountain and part of Gable Butte in the late 1980s (Neitzel 2001). Some reconnaissance of the Basalt Waste Isolation Project (BWIP) Reference Repository Location (Neitzel 2001), a proposed land exchange in T. 22 N., R. 27 E., Section 33 (Neitzel 2001), and three narrow transportation and utility corridors (Morgan 1981; Smith et al. 1977) was also conducted. Other large-scale project areas completed in recent years include the 100 Areas from 1991 through 1993 and 1995 (Chatters et al. 1992; Wright 1993); McGee Ranch (Gard and Poet 1992); the Laser Interferometer Gravitational Wave Observatory Project; the Environmental Restoration Disposal Facility; and the Washington State University 600 Area Block Survey (Andrefsky et al. 1996). To date, approximately 12 percent of the Hanford Site has been surveyed for archaeological resources.

4.7.2 Historic Archaeological Resources

Two of the early Euro-Americans who passed near the Hanford Site were Lewis and Clark, who traveled along the Columbia and Snake rivers during their 1803 to 1806 exploration of the Louisiana Territory. The first European explorer to cross the Hanford Site was David Thompson, who traveled along the Columbia River from Canada during his 1811 exploration of the Columbia River. Other visitors included fur trappers, military units, and miners who traveled through the Hanford Site on their way to lands up and down the Columbia River and across the Columbia Basin. It was not until the 1860s that merchants set up stores, a freight depot, and the White Bluffs Ferry on the Hanford Reach. Chinese

miners soon began to work the gravel bars for gold. Cattle ranches were established in the 1880s, and farmers soon followed. Agricultural development, irrigation districts, and roads soon dotted the landscape, particularly in the eastern portion of the central Hanford Site. Several small thriving towns, including Hanford, White Bluffs, Richland, and Ringold, grew up along the riverbanks in the early twentieth century. Community accessibility to outside markets grew with the 1913 arrival of the Chicago, Milwaukee, St. Paul, and Pacific Railroad branch line (Priest Rapids-Hanford Line) from Beverly, Washington. Ferries were established at Richland, Hanford, Wahluke, White Bluffs, and Richmond. The towns and nearly all other structures were razed in the years after the U.S. government acquired the land for the Hanford Engineer Works in 1943 (DOE-RL 2003a; Neitzel 2002a).

Since 1987, the Hanford Cultural Resources Laboratory (HCRL) has recorded 655 historic archaeological sites associated with the pre-Hanford (Euro-American) era, the Manhattan Project, and Cold War Era, including an assortment of farmsteads, corrals, dumps, and military sites. Of these, 56 sites contain prehistoric components as well. Archaeological resources from the pre-Hanford period are scattered over the entire Hanford Site and include numerous areas of gold mining features along the riverbanks of the Columbia and remains of homesteads, building foundations, agricultural equipment and fields, ranches, and irrigation features. Properties from this period include the Hanford Irrigation Ditch; former Hanford Townsite; Wahluke ferry landing; White Bluffs Townsite; Richmond ferry landing; Arrowsmith Townsite; White Bluffs road; and the Chicago, Milwaukee, St. Paul, and Pacific Railroad.

Areas of traditional cultural importance to pre-Hanford residents are also found on the Hanford Site. These areas include places and structures that are important to descendents of pre-1943 settlers in the former White Bluffs, Hanford, Allard, and Cold Creek areas.

4.7.3 Historic Built Environment

A number of buildings associated with the pre-Hanford Site era have been documented. They include the Hanford Irrigation and Power Company pumping plant at Coyote Rapids, the high school and the electrical substation at the Hanford Townsite, First Bank of White Bluffs, Bruggemann's fruit warehouse, and the blacksmith cabin at the East White Bluffs ferry landing.

Historic built resources documented from the Manhattan Project and Cold War eras include buildings and structures found in the 100, 200, 300, 400, 600, 700, and former 1100 and 3000 Areas. The most important of these are the plutonium production and test reactors, chemical separation and plutonium finishing buildings, and fuel fabrication/manufacturing facilities. The first reactors, 100-B, 100-D, and 100-F, were constructed during the Manhattan Project. Plutonium for the first atomic explosion and the bomb that destroyed Nagasaki was produced at the Hanford Site. Additional reactors and processing facilities were constructed after World War II during the Cold War period. All reactor containment buildings still stand, although many ancillary structures have been removed, and the C, D, DR, F, and H reactors have been considerably modified.

Historic contexts were completed for the Manhattan Project and Cold War eras as part of a National Register Multiple Property Documentation Form prepared for the Hanford Site to assist with the evaluation of National Register of Historic Places (National Register) eligibility of buildings and structures

sitewide (Bard 1997). Additionally, historical narratives and individual building documentations have been compiled in the *History of the Plutonium Production Facilities at the Hanford Site Historic District, 1943-1990*, published in 2002 (DOE-RL 2002). At the site, 528 Manhattan Project and Cold War Era buildings/structures and complexes have been determined to be eligible for the National Register as contributing properties within the designated Hanford Site Manhattan Project and Cold War Era Historic District. Of that number, 190 were recommended for individual documentation (DOE-RL 1998).

4.7.4 200 Areas

Much of the 200 East and West Areas has been disturbed by construction of facilities associated with the chemical separations process as part of the Manhattan Project and Cold War Era. Other facilities have been constructed as part of ongoing cleanup efforts for the Hanford Site. Comprehensive efforts were made in 1986 and 1989 to inventory the undisturbed portions of the 200 East and West Areas for cultural resources. The 1989 survey was "an intensive pedestrian survey of all undisturbed portions of the 200 East Area and a stratified random survey [of the undisturbed portions] of the 200 West Area" (Chatters and Cadoret 1990). No cultural resources are known to exist within currently active borrow areas (DOE 2001a).

The 1989 survey located two historic-archaeological sites (can and glass scatters), four isolated historic artifacts, one isolated cryptocrystalline flake, and an extensive linear feature (that is, the White Bluffs Road). These were the only materials older than 50 years discovered during the field survey. A prominent archaeological resource located in the 200 Areas is the extensive linear feature known as the White Bluffs Road, a portion of which passes diagonally southwest to northeast through the 200 West Area. This road, in its entirety, was determined eligible for listing in the National Register. Within the 200 West Area, two intact segments of the road are considered contributing elements: 1) the southwest segment from the perimeter fence to approximately 19th Street at Dayton Avenue, and 2) the extreme northeast segment above T Plant Complex to the perimeter fence. A 100-m (328-ft) easement has been created to protect these segments of the road from uncontrolled disturbance. The remaining portions of the road within the 200 West Area have been determined to be non-contributing. Such non-contributing segments of the White Bluffs Road are those that do not add to the historic significance of the road, but retain evidence of its contiguous bearing. Originally used as a Native American trail, it played a role in Euro-American immigration, development, agriculture, and Hanford Site operations. In 1996, an inventory was completed of the remainder of the undisturbed ground; an area totaling 2.2 km^2 (0.85 mi^2). Although six isolated finds and two historic debris scatters were located, none were considered to be eligible for the National Register. A survey of the White Bluffs Road in 2000 recorded an additional 54 historic isolated finds and 2 prehistoric isolated finds, as well as six can dump features (Neitzel 2002a).

Although other areas of undisturbed land in the 200 East and 200 West Areas have been surveyed as part of cultural resource reviews of proposed projects, no new significant cultural resources have been located. Reviews include the 1989 permit application for the LLBGs (218-E-10, 218-E-12B, 218-W-3A, 218-W-3AE, 218-W-4B, 218-W-4C, 218-W-5, 218-W-6) (Hanford Cultural Resources Case [HCRC] # 89-200-008; see Table K.1). Previous borrowing and burying activities at the grounds had extensively

disturbed the majority of the LLBGs. However, portions of 218-E-12B, 218-W-5 and 218-W-6 were undisturbed. These areas were surveyed and reviewed by the HCRL in the summer of 1988 as part of HCRC# 88-200-038 (see Table K.1) and clearance for the project was granted. The ETF location was reviewed for the presence or absence of cultural resources in 1990 (HCRC# 89-200-023; see Table K.1). The WRAP Facility location was reviewed in 1993 (HCRC# 93-200-074; see Table K.2) and the CWC was reviewed in 1995 (HCRC# 95-200-104; see Table K.1). No significant resources were identified. Over the past 15 years, 50 cultural resource reviews were conducted on the LLBGs for grouting, geologic testing, subsidence repair and maintenance, removal of contaminated soils, retrieval of vented drums, culvert installation, drilling to install high-integrity containers, and trench construction.

Chemical separations facilities (processing plants and their ancillary and support services) were located in the 200 Areas. Irradiated fuel elements were dissolved and desired materials such as plutonium were separated out. Historic property inventory forms have been completed for 72 buildings and structures in the 200 Area. Of that number, 58 have been determined to be eligible for the National Register as contributing properties within the Historic District recommended for mitigation. Included are the 234-5Z Plutonium Finishing Plant, 236-Z Plutonium Reclamation Facility, 242-Z Water Treatment Facility, 231-Z Plutonium Metallurgical Laboratory, 225-B Encapsulation Building, 221-T Canyon (T Plant) Building, 202-A Purex Building, 222-S Redox Plant, 212-N Lag Storage Facility, 282-E Pumphouse and Reservoir Building, 283-E Water Filtration Plant, and 284-W Power House and Steam Plant. The 232-Z Waste Incinerator Facility and the 233-S Plutonium Concentration Building, determined eligible for the National Register, have been documented to Historic American Engineering Record (HAER) standards (DOE-RL 1998).

Completed in December 1944, T Plant (221-T) was the world's first large-scale plutonium (chemical) separation facility. T Plant, like the other chemical separation buildings at Hanford, is a massive, concrete, canyon-like structure measuring 800 feet long, 65 feet wide, and 80 feet high. Because of its role as the primary chemical separations plant at the Hanford Site from 1944 until the opening of the REDOX Plant in 1952, T Plant was found to be eligible for inclusion in the National Register as a contributing property within the Historic District and recommended for individual documentation (mitigation). Mitigation of T Plant has been completed and consisted of a HAER documentation of the facility and a walkthrough/assessment of the building contents. Industrial artifacts at T Plant and other historic facilities in the 200 Area were identified and tagged for future exhibit purposes.

DOE entered into the Programmatic Agreement for the Maintenance, Deactivation, Alteration, and Demolition of the Built Environment on the Hanford Site (DOE-RL 1996) with the Advisory Council on Historic Preservation and the Washington State Historic Preservation Office. One stipulation of the agreement requires DOE to undertake an assessment of the contents of the historic buildings and structures prior to any deactivation, decommissioning, or decontamination activities. The purpose of these assessments is to locate any artifacts that may have interpretive and or educational value as exhibits within local, state, or national museums.

4.8 Socioeconomic Activity

Activity on the Hanford Site plays a dominant role in the socioeconomic activity of the Tri-Cities and other parts of Benton and Franklin counties. The agricultural community also has a significant effect on the local economy. Any major changes in the Hanford mission could potentially affect the Tri-Cities and other areas of Benton and Franklin counties.

4.8.1 Local Economy

Three major sectors have been the principal driving forces of the economy in the Tri-Cities since the early 1970s: 1) DOE and its contractors operating the Hanford Site; 2) Energy Northwest (formerly the Washington Public Power Supply System) in its construction and operation of nuclear power plants; and 3) the agricultural community, including a substantial food-processing component. With the exception of a minor amount of agricultural commodities sold to local-area consumers, the goods and services produced by these sectors are exported outside the Tri-Cities. In addition to the direct employment and payrolls, these major sectors also support a sizable number of jobs in the local economy through their procurement of equipment, supplies, and business services.

In addition to these three major employment sectors, three other components can be readily identified as contributors to the economic base of the Tri-Cities: payrolls from the five major non-Hanford employers in the region, tourism, and pension benefits from former employees.

4.8.1.1 Employment and Income

DOE Hanford Site Employment. During FY 2001, the DOE Office of River Protection (ORP) and its prime contractors CH2M Hill Hanford Group, Inc. and Bechtel National, Inc.; DOE-RL and its prime contractors Fluor Hanford, Inc. (and its principal subcontractors); PNNL; Bechtel Hanford, Inc.; and the Hanford Environmental Health Foundation employed an average of 10,700 employees. Fiscal year 2001 year-end employment at Hanford was 10,670, down slightly from 10,870 in FY 2000. In FY 1999, average employment was 10,290, compared with an average employment of 11,940 in 1996. The drop between FY 1996 and FY 1999 reflects employment declines and reorganization of the DOE contractors under the Project Hanford Management Contract (PHMC), which was created in 1996. Under the PHMC, almost 2200 employees of the former management and operations contractor were moved into six “enterprise companies” and were no longer counted as official Hanford employees. The number of employees at Hanford is down considerably from a peak of 19,200 in FY 1994, but still represents 12 percent of the 89,100 total jobs in the economy.

Based on employee residence records as of April 2002, 92 percent of the direct employees of Hanford live in Benton and Franklin counties. Approximately 73 percent of Hanford employees reside in Richland, Pasco, or Kennewick. More than 36 percent are Richland residents, 9 percent are Pasco residents, and 28 percent live in Kennewick. Residents of other areas of Benton and Franklin counties, including West Richland, Benton City, and Prosser, account for about 18 percent of total Hanford Site employment (Neitzel 2002a).